

# BRUSH ELECTRONICS COMPANY

EQUIPMENT DEPARTMENT

**Look To BRUSH for  
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And Equipment**

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- Physical Measurements
- Textile Measurements
- Counting and Controlling
- Resistance-Welding Measurements
- Surface Roughness Measurements
- Electro-Acoustical Measurements

■ **Equipment for:**

- Magnetic Recording



OPERATING INSTRUCTIONS FOR  
**PORTABLE FOUR AND SIX CHANNEL OSCILLOGRAPHS**

Models BL-274 D. C. and BL-276 D. C.

MP MASTER



MA34653

## WARRANTY

We warrant each instrument manufactured by Brush Electronics Company to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and replacing any defective parts thereof (except pens, tubes, fuses and batteries).

This warranty is effective for one year after delivery to the original purchaser, when the instrument is returned transportation charges prepaid by the original purchaser, and which upon our examination proves to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at our current rate. In this case, an estimate will be submitted before the work is started.

*Warranty card enclosed with shipment must be returned to establish warranty.*

### ■ Claim for damage in Shipment

The instrument should be examined as soon as it is received. If it is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained from the claim agent, and this report should be forwarded to us.

We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number, type number and serial number when referring to this instrument for any reason.

### ■ If any fault develops, the following steps should be taken:

1. Notify our Customer Service Department, 3405 Perkins Avenue, Cleveland 14, Ohio, giving full details of the difficulty, and include the model number, type number and serial number. Upon receipt of this information, we will give you service instructions or issue a material return authorization card.

2. You may request any necessary instrument pack-

aging by telling us what cartons you need. These will be sent to you no charge.

3. Upon receipt of shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

### SHIPPING

All shipment of instruments should be made via Railway Express.

**PLEASE DO NOT HESITATE TO CALL ON US**

## BRUSH ELECTRONICS COMPANY

DIVISION OF CLEVITE CORPORATION

3405 PERKINS AVENUE • CLEVELAND 14, OHIO

## PORTABLE FOUR AND SIX CHANNEL OSCILLOGRAPHS

Models BL-274 D.C. and BL-276 D.C.

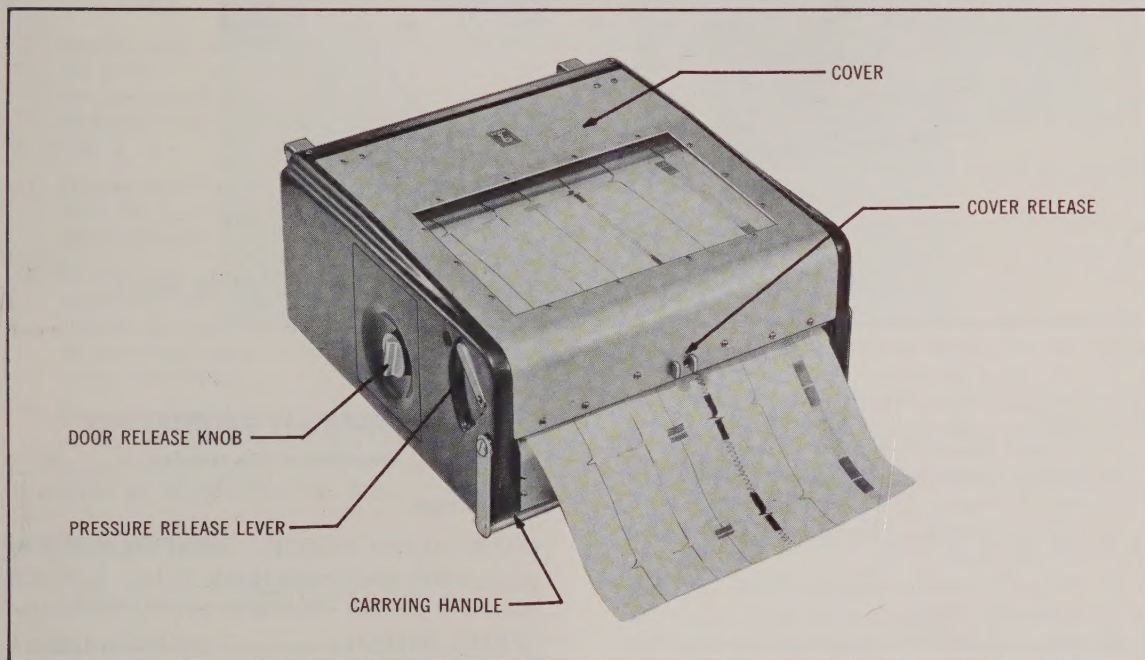


Fig. 1. Brush Portable Six-Channel Oscillograph, Model BL-276 D.C.

The Brush direct writing Portable Four and Six Channel Oscillographs combine multichannel recording in one unit with light weight, compactness and portability. They are designed for bench or table-top applications and can be readily moved from place to place to facilitate use at points of measurement and recording. Four or six Penmotors, Model BL-902A, are mounted in-line to afford four or six simultaneous recordings on one chart paper. Recording on one chart paper permits easy time correlation of the various phenomena under observation. The aluminum top-covers of the oscillographs have large windows for viewing the chart paper as the signals are being recorded. Chart paper speeds of 1, 2, 5, 10, 25, 50, 125 and 250 millimeters per second are standard. Accessory Right and Left Event Markers are available but must be installed at the factory. Either Oscillograph may be ordered for operation on 12 volts or 28 volts D.C. (but not both voltages).

Although ink writing is standard, electric writing with styluses on Teledeltos chart paper is possible if 115 volts, 50 or 60 cps is available to operate an accessory Power Supply, Model BL-993 (modified). The controls of both Oscillographs are prewired at the factory to accommodate all accessories, although either model may be purchased without accessories.

### SPECIFICATIONS

The following specifications are common to both Oscillographs, Models BL-274 D.C. and BL-276 D.C., except where otherwise specified. Specifications for accessories are included and annotated.

Magnetic Penmotors..... Model BL-902A.

Minimum Sensitivity..... 0.95 mm per volt.  
1.4 mm per milliampere.

D.C. Resistance..... 1450 ohms (nominal).

Amplitude..... 40 mm maximum  
(peak to peak) from 0 (D.C.) to 70 cps.  
20 mm maximum (peak to peak) from 70 to 100 cps.

Frequency Response..... 0 (D.C.) to 100 cps  
when properly matched with Brush amplifier.  
0 (D.C.) to 30 cps—penmotor only.

Pens (ink only)..... Model BL-963, for penmotors and accessory Event Markers. Accessory Pens, Model BL-936 are available for fine writing.

Electric Styluses..... Model BL-942, for penmotors. Model BL-970, for accessory Event Markers.

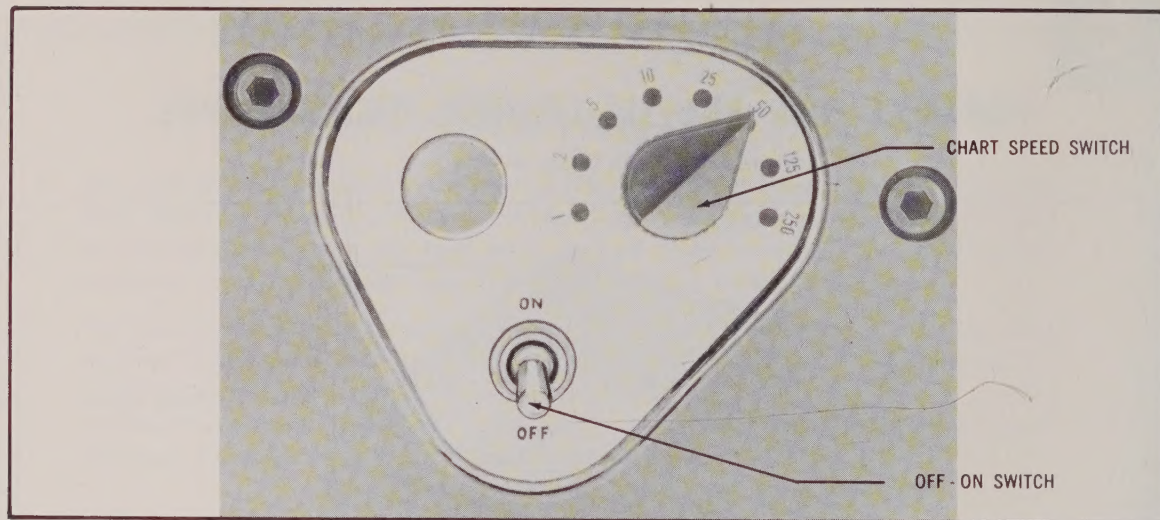


Fig. 2. View Showing Controls (on Right Side)

Chart Paper..... Model BL-941—6 channel, ink only—350 feet in length.

Model BL-981—4 channel, ink only—350 feet in length.

Model BL-984—2 channel, ink only—350 feet in length.

Model BL-940—6 channel electric—235 feet in length.

Model BL-980—4 channel electric—235 feet in length.

Model BL-979—2 channel electric—235 feet in length.

(All chart paper divided into 5 mm longitudinal divisions and 1 mm transverse divisions.)

Chart Paper Speeds..... 1, 2, 5, 10, 25, 50, 125 and 250 millimeters per second.

Power Required..... 12 or 28 v D.C., 76 watts (ink writing), 95 watts maximum at 115 v, 60 cps (electric writing) when equipped with accessory Power Supply, Model BL-993 (modified).

Dimensions..... Model BL-274 D.C., 7" high, 11 $\frac{3}{4}$ " wide and 17" deep, overall. Model BL-276 D.C., 7" high, 15" wide and 17" deep, overall.

Weight..... Model BL-274 D.C., 38 pounds. Model BL-276 D.C., 51 pounds.

Shipping Weight..... Model BL-274 D.C., 50 pounds. Model BL-276 D.C., 63 pounds.

Separate carton, 20 pounds. (Each model is accompanied by a separate carton containing a Junction Box, cables, pens, etc.)

Accessory Power Supply, Model BL-993 (modified), 12 pounds.

## CONTROLS and CONNECTORS

(including all accessories)

### RIGHT SIDE

CHART SPEED SWITCH... Rotary switch, (Fig. 2) selects chart paper speeds of 1, 2, 5, 10, 25, 50, 125 and 250 millimeters per second.

OFF-ON SWITCH..... 2 position toggle switch. Fig. 2. Main power "OFF-ON" switch.

### REAR PANEL

EVENT MARKER..... Connects either or both accessory Event Markers to an outside (customer supplied) shorting switch. 7 pin female AN connector. Fig. 3.

SIGNAL INPUT..... Signal input to each of the individual penmotors. 24 pin male AN connector. Fig. 3.

STYLUS INPUT..... Connects oscillograph with accessory Power Supply, Model BL-993 (modified), to supply power for electric writing where 115 v, 60 cps is available. 35 pin female AN connector. Fig. 3.

MAIN POWER INPUT..... Connects oscillograph with main power source (12 or 28 volts, D.C.) 3 pin male AN connector. Fig. 3.

## OPERATING PROCEDURE

The following operating procedures are designed for the Portable Six Channel Oscillograph, Model BL-276 D.C., with all accessories, but are equally applicable to the Portable Four Channel Oscillograph, Model BL-274 D.C., unless otherwise specified.

## INK WRITING

To operate the oscillograph (for ink writing only) proceed as follows:

1. Load the instrument with chart paper; mount the inkwells; mount and adjust the pens; fill the inkwells; and test the oscillograph as explained under ROUTINE ADJUSTMENT and MAINTENANCE.
2. Connect main power input cable to an appropriate power source (12 or 28 volts, D.C.) and to the rear panel of the oscillograph at the AN terminal marked "MAIN POWER INPUT". Fig. 3.
3. Connect the SIGNAL INPUT terminal (Fig. 3.) with the Junction Box by means of the 25 ft. cable supplied.
4. Connect the cables from the amplifiers to the respective connectors of the Junction Box. The connectors are identified on the Junction Box in numerical order corresponding to the individual penmotors.

5. Select the chart paper speed desired by means of the CHART SPEED SWITCH. Fig. 2.

The oscillograph is now set up for operation and is actuated by the OFF-ON SWITCH.

## ELECTRIC WRITING

To set up the oscillograph for electric writing where 115v, 60 cps, is available, proceed as follows:

1. Disconnect all connectors on the rear panel of the oscillograph.
2. Remove the pens and inkwells. See ROUTINE ADJUSTMENT and MAINTENANCE.
3. Remove the ink writing chart paper, if any, and in any event, load the oscillograph with Teledeltos electric writing chart paper. See ROUTINE ADJUSTMENT and MAINTENANCE.
4. Mount, connect and adjust the electric styluses. See ROUTINE ADJUSTMENT and MAINTENANCE.
5. Turn the OFF-ON SWITCH to "OFF".
6. Connect the MAIN POWER INPUT terminals to an appropriate power source (either 12 volts or 28 volts D.C. as shown on the name plate).
7. Connect the accessory Power Supply, Model BL-993 (modified), to the STYLUS INPUT (AN) connector on the rear panel. Fig. 3.
8. Turn *all* OFF-ON switches on the accessory Power Supply to positions marked "OFF".
9. Connect the accessory Power Supply to an appropriate power source (115 volts, 60 cps).
10. Turn the OFF-ON SWITCH on the side of the oscillograph to "ON".
11. Turn *all* the OFF-ON switches on the accessory Power Supply to "ON".

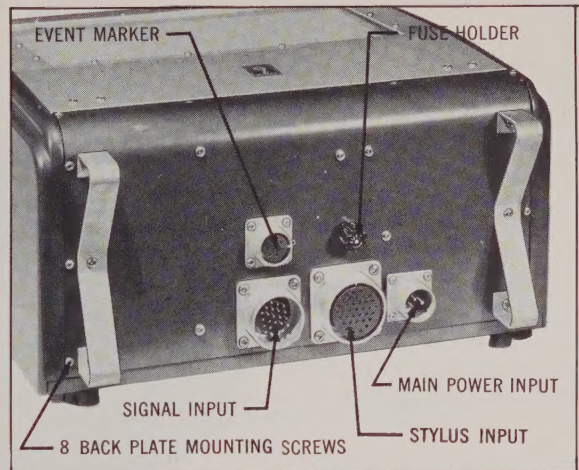


Fig. 3. View of Rear Panel

12. Manually center the styluses on the center lines of each channel of the chart paper.  
*Warning: Do not under any circumstances touch the electric styluses while they are energized.*
13. Turn *all* the OFF-ON switches on the accessory Power Supply to "OFF".
14. Turn the OFF-ON SWITCH on the side of the oscillograph to "OFF".
15. Connect the SIGNAL INPUT terminal (Fig. 3) with the Junction Box by means of the cable supplied.
16. Connect the cables from the amplifiers to the respective connectors of the Junction Box. The connectors are identified on the Junction Box in numerical order corresponding to the individual penmotors.
17. Select the chart paper speed desired by means of the CHART SPEED SWITCH. Fig. 2.

The oscillograph is now set up for electric writing and is in a standby condition.

## EVENT MARKERS

To operate the accessory Event Markers it is necessary to solder two leads from switch (customer supplied) to the male portion of the AN connector matching the female AN connector on the back of the oscillograph. Fig. 3. Pin "G" of the connector is the "hot" or common pin while pin "A" completes the circuit to the Right Event Marker and pin "F" completes the circuit to the Left Event Marker. After soldering and re-assembling the male portion of the connector, it is only necessary to connect the cable to the oscillograph. The Event Markers will now operate automatically or manually as determined by the type of switch selected and installed by the operator.

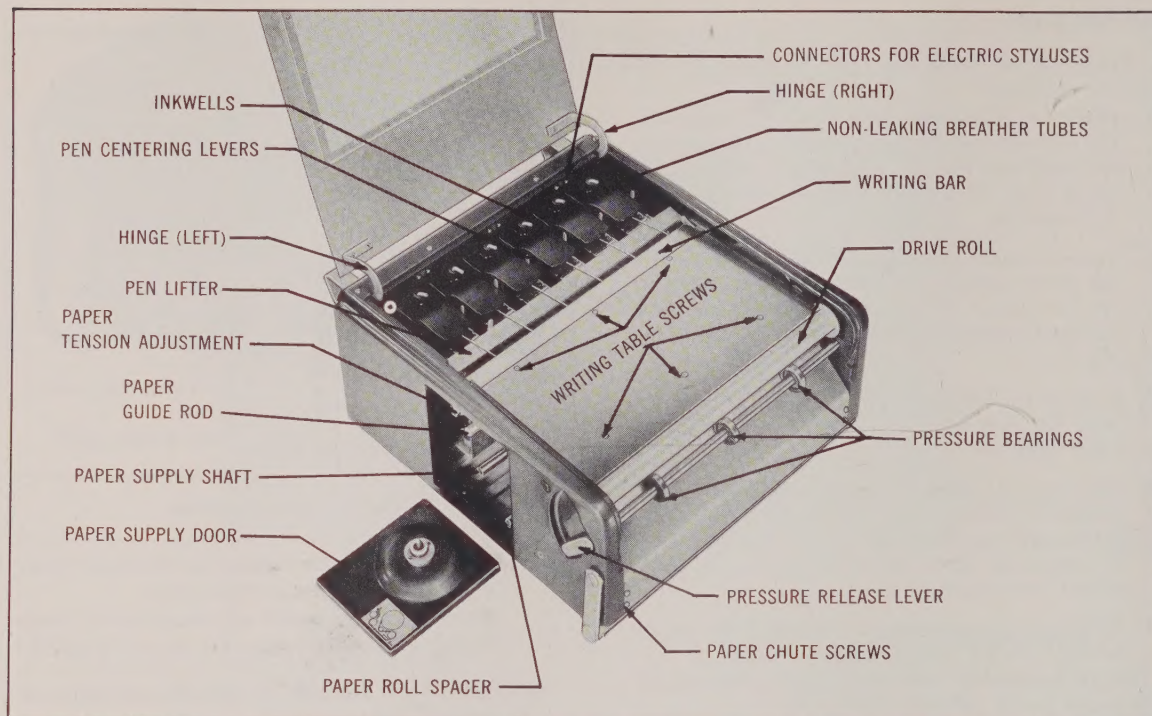


Fig. 4. General View—Indicating Various Parts

## ACCESSORIES

### EVENT MARKERS

The Event Markers, Model BL-452R D.C. (right), BL-452L D.C. (left) and BL-452T D.C. (both), are relay powered pen or electric stylus holders. They are internally powered but actuated externally by means of some type of switch (customer supplied). Each Event Marker is supplied with one ink pen as standard equipment. Electric styluses are available.

**CAUTION:** When Equipped for Electric Writing, Any Event Marker Pen is "Hot" when the Ink-Off-Electric Switch is in the Electric Position.

### POWER SUPPLY

#### For Electric Writing

The Power Supply, Model BL-993 (modified) is designed to operate on 115v, 60 cps. Where such current is available, it permits the use of electric styluses and Teledeltos chart paper for electric writing.

## ROUTINE ADJUSTMENT and MAINTENANCE

### SPECIAL TOOLS

Special tools for adjusting and maintaining the oscillograph are supplied in a small leather tool kit. These tools are:

1. A syringe for cleaning ink pens.
2. A gram gage for measuring pen pressure.
3. A tension adjustment tool for adjusting the PRESSURE SPRING of the pen and stylus holder. Fig. 7.
4. A set of two adjustment wrenches.

### TO REPLACE CHART PAPER

To replace chart paper proceed as follows:

1. Remove the PAPER SUPPLY DOOR. Fig. 4.
2. Cut the end of the chart paper at an angle of approximately 45°. The point of the chart paper must be on the PAPER SUPPLY DOOR side. This will facilitate threading the chart paper through the oscillograph.
3. Lift the COVER of the oscillograph by means of the COVER RELEASE. Fig. 1.
4. Lift the pens or styluses with the PEN LIFTER. Fig. 4.
5. Slip the new supply of chart paper over the PAPER SUPPLY SHAFT as shown. Fig. 4. (If a paper core from a previous supply is on the PAPER SUPPLY SHAFT, remove and discard it.) Do not press the new paper supply forcibly against the Paper Centering Collar as this will force the roll into a conical shape which may prevent the chart paper from unwinding in proper alignment.

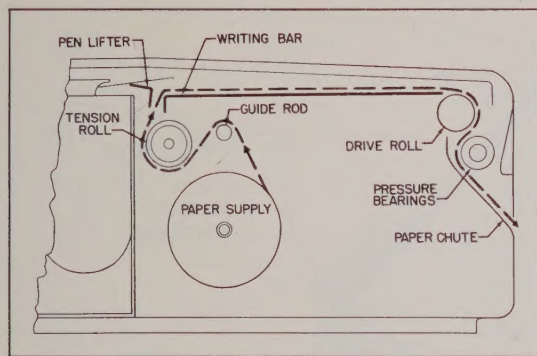


Fig. 5. Method of Loading Chart Paper

6. Lead the pointed end of the chart paper over the GUIDE ROD; under the TENSION ROLL; up and over the WRITING BAR. Fig. 5. Care should be exercised not to snag the tips of the pens or styluses with the end of the chart paper.
7. Release the tension on the PRESSURE BEARINGS (Fig. 4 and 5) by means of the PRESSURE RELEASE LEVER. Fig. 4.
8. Pull the chart paper over the writing table and DRIVE ROLL. Fig. 4 and 5.
9. Insert the chart paper in the top of the PAPER CHUTE beneath the PRESSURE BEARINGS.
10. Withdraw the chart paper two or three inches from the front of the oscillograph.
11. Release the PRESSURE RELEASE LEVER.
12. Lower the pens or styluses onto the chart paper by means of the PEN LIFTER.
13. Close and snap shut the COVER.
14. Replace and fasten the PAPER SUPPLY DOOR. Fit the door snugly. When tightened, the DOOR RELEASE KNOB which is spring loaded, will put the correct amount of pressure on the PAPER SUPPLY roll.
15. Run a short test length of chart paper to determine that it runs in proper alignment. The oscillograph is checked for alignment of the chart paper drive before it leaves the factory.

**NOTE:** In the event that it is desirable to use two or four channel chart paper in the Six Channel Portable Oscillograph, or two channel chart paper in the Portable Four Channel Oscillograph, it may be done by slipping the appropriate spacer sleeve over the PAPER SUPPLY SHAFT *before* placing the new paper supply in the oscillograph. Inside the case of the Portable Six Channel Oscillograph are two spacer sleeves mounted in spring clips. The longer one is for use with two channel chart paper while the shorter one is for use with four channel chart paper. One spacer sleeve is supplied with the Portable Four Channel Oscillograph. Access to the spacer sleeves is by way of the PAPER SUPPLY DOOR.

## RE-ALIGNMENT OF CHART PAPER

When properly aligned the edges of the chart paper will be equally distant from the inside edges of the shoulder of the side castings into which the COVER fits. This measurement should be taken in line with the DRIVE ROLL. If the chart paper is not equally distant, it may be re-aligned as follows:

1. Remove the PAPER SUPPLY ROLL. Fig. 5.
2. Remove the socket-head screw and lockwasher on the control side of the oscillograph, holding the PAPER GUIDE ROD. Fig. 4. In withdrawing the PAPER GUIDE ROD note the inside lockwasher between the PAPER GUIDE ROD and the inside of the side casting.
3. Loosen (but do not remove) by means of the small adjustment wrench in the tool kit, the set screw positioning the Paper Centering Collar.
4. Slide the Paper Centering Collar *either* to the *right* or to the *left* a distance equal to *one-half* the *difference* of the distances between the edges of the chart paper and the inside edges of the shoulders of the side castings into which the Cover fits.
5. Tighten the set screw holding the Paper Centering Collar. (This is important.)
6. Replace the PAPER GUIDE ROD with the inside lockwasher in the side casting.
7. Fasten tightly in place with the socket-head screw and lockwasher.
8. Replace the chart paper and test for alignment.
9. If necessary, repeat above steps.

## TO MEASURE and ADJUST

### CHART PAPER TENSION

The oscillograph leaves the factory with the chart paper tension adjusted for ink writing (1½ to 2 pounds) unless otherwise specified. Electric writing requires a chart paper tension of 2 to 2½ pounds. Incorrect chart paper tension results in the paper not remaining flat on the writing table (tension too loose) or a squeaking sound as the chart paper is pulled over the WRITING BAR (tension too tight). Tension that is too tight will result in slowing the speed of the chart paper and a consequent error in the time factor of the graph. To *measure* the chart paper tension, proceed as follows:

1. Remove the paper from the PAPER CHUTE at the front of the oscillograph. Allow the paper to be free on the writing table.
2. Fasten one end of a strip of cellophane tape around the hook of a spring scale. (customer supplied).
3. Fasten the other end of the cellophane tape firmly along the center line of the chart paper.

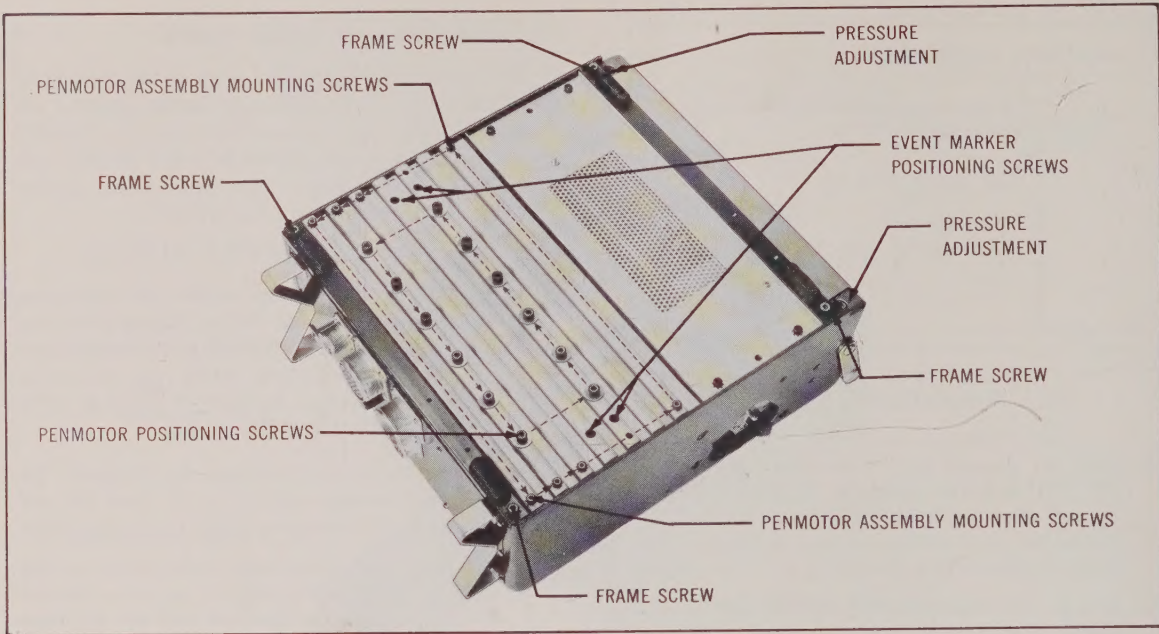


Fig. 6. View of Underside of Oscilloscope

4. Pull the chart paper by means of the spring scale along the top of the writing table. As the chart paper unwinds from the SUPPLY ROLL, the scale should read between 1 and 1½ pounds for ink writing chart paper and between 2 and 2½ pounds for electric writing paper. These amounts will increase slightly with a partially used SUPPLY ROLL of chart paper.

To *adjust* the chart paper tension proceed as follows:

1. Remove the PAPER SUPPLY DOOR. Fig. 4.
2. With a screwdriver hold the slot of the PAPER TENSION ADJUSTMENT to prevent its turning. Fig. 4.
3. Loosen the locknut of the PAPER TENSION ADJUSTMENT.
4. Turn the screwdriver slot in the proper direction to attain the tension desired. (Turning in a *clockwise* direction *decreases* the tension while turning in a *counterclockwise* direction *increases* the tension.)
5. Hold the screwdriver slot to prevent its turning and tighten the locknut securely. This is important.
6. Replace the PAPER SUPPLY DOOR.
7. Re-measure the chart paper tension and re-adjust, if necessary.

#### TO MEASURE and ADJUST PRESSURE BEARINGS

The PRESSURE BEARINGS are adjusted to exert 12 to 14 pounds pressure against the DRIVE ROLL.

Fig. 5. This pressure may be measured and checked in the following manner:

1. Place the instrument near the front edge of a solid work surface.
2. Remove the chart paper from the PAPER CHUTE at the front of the instrument.
3. Place the PRESSURE RELEASE LEVER in an "up" or "on" position.
4. Place the hook of a spring scale around the shaft of the PRESSURE BEARINGS at a point close to either end bearing.
5. Put tension on the spring scale as near as possible directly downward, until the PRESSURE BEARING is tension free of the DRIVE ROLL. This may be determined by slowly rotating the PRESSURE BEARING by hand. The reading on the scale should be between 12 and 14 pounds.
6. Measure the opposite PRESSURE BEARING in the same manner. Both PRESSURE BEARINGS must be at equal tension. Disregard the center PRESSURE BEARING on the Six Channel Oscilloscope.

To adjust the tension on the PRESSURE BEARINGS, proceed as follows:

1. Place the instrument on a work surface in such a manner that several inches of the front of the instrument project beyond the edge of the work surface.
2. Adjust the tension of the PRESSURE BEARINGS to the desired tension by means of the

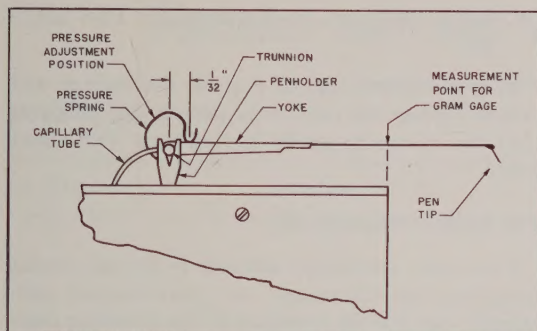


Fig. 7. Pen Mounting Diagram

two PRESSURE ADJUSTMENT screws recessed in the corners of the underside of the frame. Fig. 6. (Turning the PRESSURE ADJUSTMENT screws "in" *increases* the tension while "backing-off" the screws *decreases* the tension.)

3. Measure the tension on *both* outside PRESSURE BEARINGS, again. Re-adjustment may be necessary until *both* PRESSURE BEARINGS measure equally and in the range between 12 and 14 pounds.

## CARE OF INK PENS

### To Mount Pens

The following information is equally applicable to both oscillograph pens and the event marker pens. To mount the pens proceed as follows:

1. Fasten the CAPILLARY TUBE to the INK-WELL and insert the INKWELL in its holder.
2. Position the CAPILLARY TUBE so that it will project directly below and behind the TRUNNION. Failure to properly place the CAPILLARY TUBE may have a damping effect on the PEN action.
3. Mount the PEN by grasping it between the fingers or with non-magnetic tweezers at the YOKE and in front of the TRUNNION. Insert first one side of the TRUNNION and then the other in the TWIN BRACKETED PENHOLDER without over-extending the PRESSURE SPRING. Fig. 7.
4. Test the PEN pressure by means of a gram gage, Brush Model BL-801. The gram gage should be held immediately in front of the penmotor, at right angles to the PEN, in a horizontal position (at point indicated in Fig. 7). Then PEN pressure should measure exactly 1 gram with the PEN TIP barely off the paper. If it does *not* measure 1 gram, it must be adjusted.

### To Adjust Pen Pressure

To adjust the PEN pressure, proceed as follows:

1. Remove the PEN by reversing the procedure as in step 3, above.

2. Insert the pen pressure adjusting tool in the PRESSURE SPRING at point indicated in Fig. 7. Rotate the adjusting tool in the desired direction. (Rotation *toward* the chart paper *increases* the pen pressure while rotation *away* from the chart paper *decreases* the pen pressure.)

3. Remount the PEN.

4. Measure the pen pressure again and if 1 gram of pressure is not obtained, repeat the above procedure until the pen pressure is 1 gram.

Normally the PRESSURE SPRING should extend  $\frac{1}{32}$ " beyond the TRUNNION as shown in Fig. 7. But if sufficient pressure is not obtained in this position, it may be advanced slightly but not to exceed  $\frac{1}{16}$ ".

## TO FILL INKWELLS

To fill INKWELLS proceed as follows:

1. Remove the rubber stopper and by means of a medicine dropper (or the dropper supplied with the small size bottle of Brush ink) fill the INKWELL.
2. Replace the stopper.
3. To start the ink flowing, *empty* the medicine dropper and insert it tightly in the small breather hole in the top of the stopper. By depressing a few times on the bulb of the medicine dropper, the ink will begin to flow. The dropper must be held tightly in the stopper to prevent the ink from squirting.
4. The ink will continue to flow by capillary action. Always keep the pen on the chart paper when not in use as this prevents the ink from drying in the PEN TIP.

It is recommended that both the PEN and INKWELL be removed and thoroughly cleaned if the oscillograph remains unused for more than three days. It is important to clean the INKWELL because of possible accumulation of residual dust in the bottom of the INKWELL, which if allowed to remain will result in clogging the PEN. Even though in constant use it is well to clean the INKWELL occasionally for the same reason.

## TO CLEAN PENS

If the PEN should become clogged, it can be cleaned by the use of the Brush Plastic Syringe (Part No. 118266-501). This syringe is spring loaded. If the plunger of the syringe is depressed and released, it will return to its original position. To clean a clogged Pen, proceed as follows:

1. Remove the PEN and the INKWELL from the oscillograph.
2. Remove the CAPILLARY TUBE from the INKWELL. Do not attempt to remove the CAPILLARY TUBE from the PEN.

3. Depress the plunger of the syringe and, while the plunger is depressed, insert the needle in the end of the CAPILLARY TUBE. Continue to hold the plunger depressed.
4. Insert the PEN TIP in a tumbler of room temperature water (avoid contact of the PEN TIP with the side or bottom of the tumbler) and release the plunger. The vacuum thus created will tend to draw water from the outside of the PEN into the syringe. **WARNING: IT IS IMPORTANT TO FOLLOW THIS PROCEDURE IN USING THE PLASTIC SYRINGE, SINCE THE TIP OF THE PEN IS TAPERED ON THE INSIDE, AND THE WATER MUST COME FROM THE OUTSIDE OF THE PEN TIP.**

The syringe may be depressed repeatedly until water enters the PEN or syringe. Then the syringe must be removed from the CAPILLARY TUBE, emptied, and the procedure repeated. Otherwise, re-clogging of the PEN will result. If this procedure does not clear the PEN, soak it overnight in room temperature water and use the syringe again.

If none of these methods results in clearing the PEN, return it to the BRUSH ELECTRONICS COMPANY, Customer Service Department, 3405 Perkins Avenue, Cleveland 14, Ohio.

Pens are not subject to warranty, but may be exchanged for a nominal charge.

### CARE OF ELECTRIC STYLUSES

Electric styluses are mounted in the same manner as ink pens. The same care should be used to guide the leads below and behind the TRUNNIONS to avoid any possible damping effect on the action of the stylus. Plug the leads from the styluses into their respective connectors which are located behind and above the penmotors. Fig. 4.

Occasionally carbon deposits may form on the styluses. These deposits may be removed as follows:

1. Turn the accessory Power Supply to position marked "OFF". This is important as the styluses have a very high voltage.
2. Lift the styluses by means of the PEN LIFTER.
3. Wipe the tips of the styluses between the thumb and forefinger.

4. Lower the styluses by means of the PEN LIFTER.

If it is not desirable to stop the oscillograph and carbon deposits do form, it is sometimes possible to clear the styluses by gently tapping them with a lead pencil.

### TO ALIGN PENMOTORS

Penmotors are factory aligned. If for any reason (dropping the instrument, etc.) they become misaligned, they may be re-aligned in the following manner:

1. Disconnect all cables attached to the instrument.
2. Securely block-up the instrument on a solid work surface, sufficiently high to allow working space beneath. (Usually two 2x4's placed on edge under the front and under the back of the instrument are adequate.)
3. While keeping the instrument blocked up, loosen very slightly, the PENMOTOR POSITIONING SCREWS of the particular penmotor to be adjusted. Fig. 6. Usually  $\frac{1}{4}$  of a full turn is sufficient.
4. Grasp the penmotor in both hands and move slightly in the proper direction. Do not tap the penmotor with a hammer or any tool as this may affect the magnetism.
5. Test the alignment by gently moving the pens in succession, across the chart paper. The chart paper must be taut on the writing surface. The pen tips must be within  $\pm\frac{1}{64}$ " at a line perpendicular to the edge of the chart paper to meet factory standards. This is a function of the forward and backward adjustment of the penmotor. Also, the arc struck by the pen must match the printed arc on the chart paper within  $\pm.005$ " measured at full deflection to meet factory standards. This is a function of the lateral adjustment of the penmotor.
6. Tighten securely the PENMOTOR POSITIONING SCREWS previously loosened.
7. Re-test as in step 5 above. If necessary repeat above alignment procedure.
8. Reconnect all cables to the instrument.

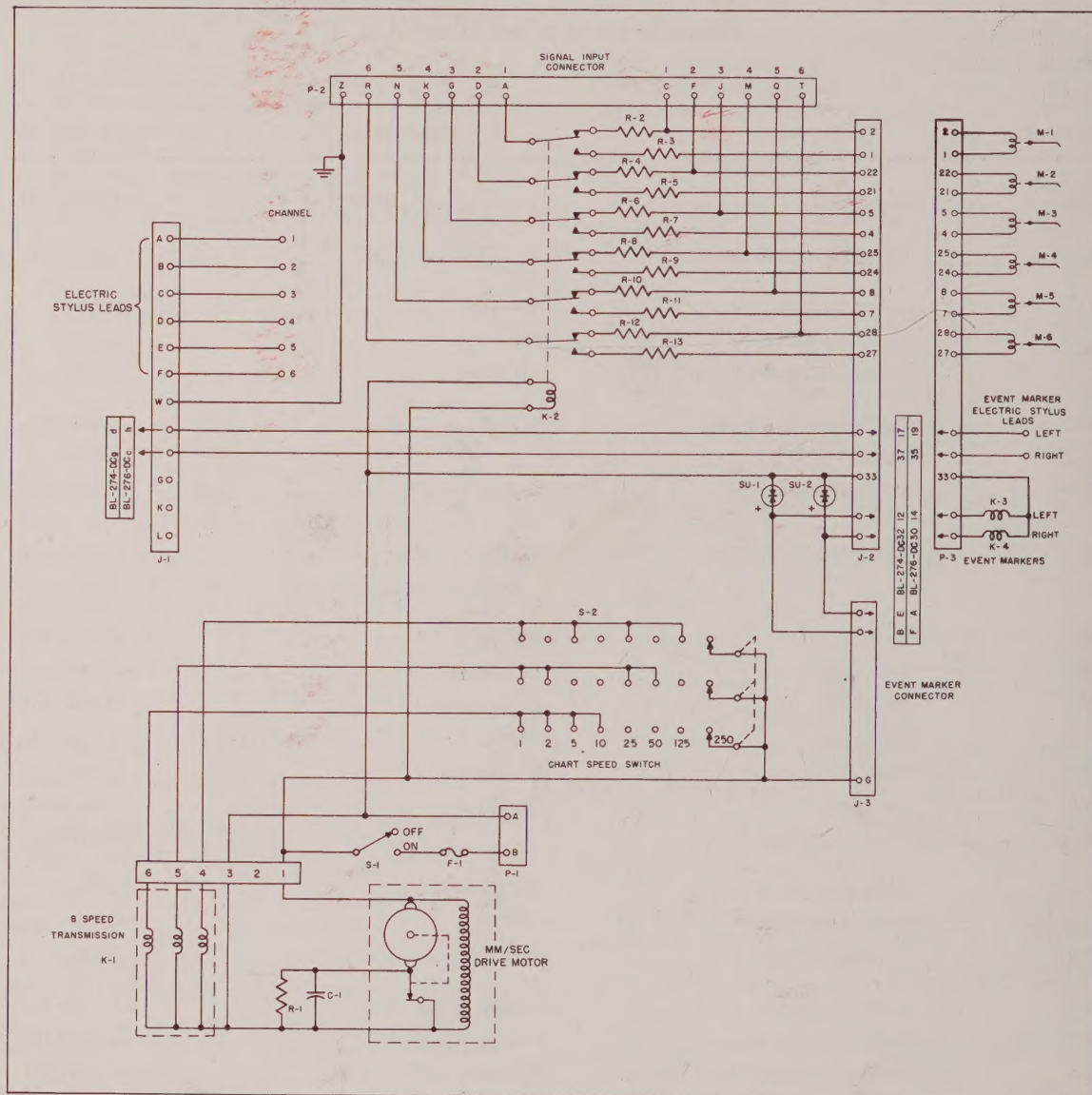
# PORTABLE FOUR AND SIX CHANNEL OSCILLOGRAPHS

Models BL-274 D. C. and BL-276 D. C.

## PARTS LIST

| Symbol | Description              | Remarks                                        | Brush Part No. |
|--------|--------------------------|------------------------------------------------|----------------|
| C-1    | Capacitator, Paper       | .1 mfd, $\pm 10\%$ , 600V                      | 10-112092-104  |
| F-1    | Fuse, 3 amp, 250V        | Type 3AG "Slo Blo"                             | 116198-14      |
| J-1    | Receptacle, Female       | AN Type                                        | 120408         |
| J-2    | Receptacle, Female       | Strip Type                                     | 117572         |
| J-3    | Receptacle, Female       | AN Type                                        | 120404         |
| K-1    | Transmission, 8 speed    | BL-440                                         | 216972-501     |
| K-2    | Relay, 6 Pole D.T.       |                                                | 124044         |
| K-3    | Event Marker, Left       | Part of BL-452L D.C.<br>Left Event Marker Kit  | 119781-501     |
| K-4    | Event Marker, Right      | Part of BL-452R D.C.<br>Right Event Marker Kit | 119782-501     |
| M-1    | Penmotor                 | BL-902-A                                       | 315066-501     |
| M-2    | Penmotor                 | BL-902-A                                       | 315066-501     |
| M-3    | Penmotor                 | BL-902-A                                       | 315066-501     |
| M-4    | Penmotor                 | BL-902-A                                       | 315066-501     |
| M-5    | Penmotor                 | BL-902-A                                       | 315066-501     |
| M-6    | Penmotor                 | BL-902-A                                       | 315066-501     |
| M-7    | Motor, Fast Speed        |                                                | 324479         |
| P-1    | Receptacle, Male         | AN Type                                        | 121323         |
| P-2    | Receptacle, Male         | AN Type                                        | 120399         |
| P-3    | Receptacle, Male         | Strip Type                                     | 117571         |
| R-1    | Resistor, Ceramic        | 5 ohms, $\pm 5\%$ , 25W                        | 5-122959-5RO   |
| R-2    | Resistor, Composition    | 1.5K, $\pm 5\%$ , $\frac{1}{2}$ W              | 5-115557-152   |
| R-3    | Resistor, Composition    | 270 ohms, $\pm 5\%$ , $\frac{1}{2}$ W          | 5-115557-271   |
| R-4    | Resistor, Composition    | 1.5K, $\pm 5\%$ , $\frac{1}{2}$ W              | 5-115557-152   |
| R-5    | Resistor, Composition    | 470 ohms, $\pm 5\%$ , $\frac{1}{2}$ W          | 5-115557-471   |
| R-6    | Resistor, Composition    | 1.5K, $\pm 5\%$ , $\frac{1}{2}$ W              | 5-115557-152   |
| R-7    | Resistor, Composition    | 560 ohms, $\pm 5\%$ , $\frac{1}{2}$ W          | 5-115557-561   |
| R-8    | Resistor, Composition    | 1.5K, $\pm 5\%$ , $\frac{1}{2}$ W              | 5-115557-152   |
| R-9    | Resistor, Composition    | 560 ohms, $\pm 5\%$ , $\frac{1}{2}$ W          | 5-115557-561   |
| R-10   | Resistor, Composition    | 1.5K, $\pm 5\%$ , $\frac{1}{2}$ W              | 5-115557-152   |
| R-11   | Resistor, Composition    | 470 ohms, $\pm 5\%$ , $\frac{1}{2}$ W          | 5-115557-471   |
| R-12   | Resistor, Composition    | 1.5K, $\pm 5\%$ , $\frac{1}{2}$ W              | 5-115557-152   |
| R-13   | Resistor, Composition    | 270 ohms, $\pm 5\%$ , $\frac{1}{2}$ W          | 5-115557-271   |
| S-1    | Switch, Toggle, S.P.S.T. |                                                | 123019         |
| S-2    | Switch, Rotary           |                                                | 117999         |

## SCHEMATIC DIAGRAM



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